Number of species and relative abundance of gamefish and rough fish using floodplain habitats

Expectation:	Relative abundance of fish within restored broadleaf marsh habitats will consist of approximately 30% game fish and 2-8% rough fish species. Gamefish should include 4-9 species belonging to the Families Centrarchidae and Esocidae, while rough fish populations should be represented by 3-6 indicator species (Table 1). Age class distributions of centrarchids and esocids should be skewed toward juveniles and young of the year.
Author:	J. Lawrence Glenn, III, South Florida Water Management District
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Relevant Endpoint(s):	Restoration - Biological Integrity - Community Structure Restoration - Biological Integrity - Reproductive Success/Recruitment Restoration - Biological Integrity - Population Structure Restoration - System Functional Integrity - Habitat Quality Restoration - System Functional Integrity - Habitat Use
Baseline Conditions:	Channelization of the Kissimmee River led to drainage of approximately 12,000 hectares of floodplain wetlands and remaining floodplain habitats typically lack connectivity with the river channel (except during flood conditions), are shallow and ephemeral, and devoid of substantial water level fluctuations. Hence, these habitats are inhospitable for populations of large bodied fish species. Three floodplain habitats (broadleaf marsh, woody shrub, and pasture) within pools A, C, and D were sampled monthly between August 1997 and January 1999 using a m^3 throw trap. *Gambusia holbrooki* and *Heterandria formosa* comprised approximately 60.7% of all fish sampled during the baseline period. Only one gamefish (*Lepomis macrochirus*) and no rough fish were collected during baseline sampling. Milleson (1976) found that the floodplain fish community of a re-flooded marsh (impounded) in pool B also was dominated by Poeciliids (79%). Centrarchids (7 species) and cyprinodontids (3 species) comprised approximately 18% of fishes collected. No rough fish were collected. Toth (1991) found that the fish community of a revitalized broadleaf marsh in pool B was dominated in abundance by Poeciliids (97%). The remaining 3% was comprised of 10 species (3 centrarchid and no rough fish species).
Reference Conditions:	Historical data on floodplain fish community structure of the Kissimmee River ecosystem are limited to a single report (FGFWFC 1957). Consequently, reference conditions were derived from relevant data from the FGFWFC (1957) report and comparable river/floodplain and marsh ecosystems. In the FGFWFC study, a floodplain broadleaf marsh was sampled using block nets and emulsified rotenone. Twenty-four species (Table 2) were collected in a 0.10 ha sample of marsh. Seven species of the Families Centrarchidae and Esocidae comprised approximately 35.7% of the total number of fish sampled. The remaining 64.3% were rough fish (1.4%) and small-bodied forage

fishes (62.9%). Rough fish were represented by a single species (*Erimyzon sucetta*). Of the 329 centrarchids and esocids sampled, 98% were juveniles or young of the year. These data suggest that historical broadleaf marsh habitats served as spawning and nursery habitats for large-bodied river fishes.

The lower Mississippi River was used as a reference site for floodplain fish assemblages of the historic Kissimmee River because some of the gamefish and rough fish species that are found in both rivers utilize inundated floodplain habitats when available. Guillory (1979) found 62 species utilized inundated floodplain habitats of the lower Mississippi River. Seven gamefish species (*Esox americanus, Lepomis gulosus, Lepomis macrochirus, Lepomis microlophus, Lepomis punctatus, Micropterus salmoides, Pomoxis nigromaculatus*) and three species of rough fish (*Amia calva, Dorosoma cepedianum, Lepisosteus platyrhincus*), which also occurred within the historic Kissimmee River, comprised 8.8% and 3.4%, respectively, of the total number of fishes collected. Five species of gamefish (*Esox americanus, Lepomis gulosus, Lepomis macrochirus, Lepomis microlophus, Pomoxis nigromaculatus*) and 2 rough fish species (*Amia calva, Dorosoma cepedianum*) collected were young-of-the-year or adults in spawning condition, indicating inundated floodplain habitats of the lower Mississippi River serve as nursery areas.

The Florida Everglades serves as a reference site for floodplain fish assemblages of the historic Kissimmee River due to similarities in geology, ecoregion, climate and annual rainfall, wetland marsh hydroperiod and vegetation composition, and zoogeography of freshwater fish fauna. Trexler et al. (in press) found Centrarchids and Esocids comprised 7 of the 16 species (*Esox americanus, Esox niger, Lepomis gulosus, Lepomis macrochirus, Lepomis microlophus, Lepomis punctatus, Micropterus salmoides*) collected in the Florida Everglades and accounted for 27% of the total number of fishes sampled. Rough fish accounted for three (*Amia calva, Erimyzon sucetta, Lepisosteus platyrhincus*) of the 16 species collected, but comprised approximately 60% of all large-bodied fishes sampled (n = 583). Jordan et al. (1999) found rough fish species made up 0.5% of the fishes sampled (n = 45,000) within wet prairie habitats in the Florida Everglades.

Mechanism relating restoration

Re-establishment of historic hydrologic characteristics will be the mechanism driving the restoration of floodplain habitats. Re-establishment of appropriate inundation depths, increased dissolved oxygen levels, and recreation of backwater lakes and ponds (deep water refuge) are critical to restoration of the floodplain fish community (Welcomme 1979). Re-establishment of both wetland flora and invertebrate fauna are linked to these characteristics and are necessary for sustaining floodplain fish populations. Restoration of floodplain fish populations will occur through re-colonization by fish species occurring within the channelized system. Newly created wetland habitats are expected to sustain fish assemblages structured similarly to those that occurred within the pre-channelized system. Young of the year and juvenile populations will be established within floodplain habitats by fish spawned on the floodplain and those migrating from adjacent riverine spawning grounds (Welcomme 1979).

Adjustment for External Constraints:	No species were extirpated from the Kissimmee River ecosystem following channelization. Relative abundance of gamefish and rough fish species may be affected by increased use of floodplain habitats by exotic fish species. Seven species (*Astronotus ocellatus, Clarias batrachus, Ctenopharyngodon idella, Cyprinus carpio, Hoplosternum littorale, Hypostomus plecostomus, Oreochromis aureus*) of exotic fishes currently occur within the channelized Kissimmee River system. The majority of these species use marsh habitat during a portion of their life cycle (Lever, 1996, McCann et al. 1996; Nico et al 1996). Numbers of exotic fish initially may be high during interim periods of physical and chemical change on the floodplain. Several exotic species within the system possess adaptations for survival in less than optimal conditions (i.e., capable of breathing air and locomotion over land) and often thrive in newly disturbed habitats (Courtenay & Hensley 1979). Established exotic communities can outcompete indigenous centrarchid communities for food, spawning areas, and space (Courtenay & Hensley 1979). However, during baseline sampling exotics comprised only 0.6% of fishes collected on the floodplain and 1.5% of the river channel fish community. Species richness and percentage of community composition of exotic species could increase if new species are introduced into the system (Table 3).
Time course:	Fish will begin migrating onto floodplain habitats following inundation (Welcomme 1979, Furse et al. 1996). However, maintenance of fish communities requires restoration of lower trophic levels within the floodplain ecosystem and may take between 3-12 years. Results of the demonstration project (Toth 1993) and test fill project indicate colonization of wetland plant species on re-inundated floodplain can be rapid. Harris et al. (1995) have suggested re-establishment of the historic invertebrate community may take 3-8 years. However, this time frame could be considerably shorter (1 year) if a representative complement of vegetation and associated periphyton community becomes established (J. Koebel, pers. com.). Restoration time frames may require adjustment if appropriate hydrologic characteristics are not met or are delayed.
Means of evaluation	Throw trap sampling will begin immediately following inundation of floodplain habitats. Throw trap sampling provides accurate estimates of density, size structure, and relative abundance of fish populations within heavily vegetated habitats (Kushlan 1981, Freeman et al. 1984, Jacobsen & Kushlan 1987, Chick et al. 1992, Jordan et al. 1997) and provides data comparable to block net sampling (Jordan et al. 1997). Methods will be identical to those utilized for baseline studies. Sampling will be conducted monthly, for two-year periods, beginning on the 1st, 5th, and 9th years following floodplain inundation. Frame nets (modified hoopnets) will be used in post-restoration sampling to sample fish movements onto and off of the floodplain and to estimate the relative abundance of large-bodied species within floodplain habitats. A series of nets will be deployed 10 and 250 m from the river channel. Sampling will be conducted biannually (wet season, dry season) within pools A and C. Frame net sampling will be carried out every other year (i.e., 1, 3, 5….etc.) for 10 years following floodplain inundation.

Samples will be analyzed for species composition and richness, relative abundance of functional groups (gamefish and rough fish), and relative abundance of size classes for each functional group. Age class of centrarchids and esocids will be based on total body length (Table 4). Differences in these data within like habitats between pools will be determined using ANOVA.

Table 1. Indicator species and expected species richness for floodplain fish community structure in re-established broadleaf marsh habitats.

Indicator Species	Species Richness
GAMEFISH	
Esox ameicanus (redfin pickerel)	4 - 9
Esox niger (chain pickerel)	
Micropterus salmoides (largemouth bass)	
Lepomis auritrus (redbreast sunfish)	
Lepomis gulosus (warmouth)	
Lepomis machrochirus (bluegill)	
Lepomis microlophus (redear sunfish)	
Lepomis punctatus (spotted sunfish)	
Pomoxis nigromaculatus (black crappie)	
ROUGH FISH	
Amia calva (bowfin)	2 - 5
Dorosoma cepedianum (gizzard shad)	
Erimyzon sucetta (lake chubsucker)	
Lepisosteus osseus (longnose gar)	
Lepisosteus platyrhincus (Florida gar)	

Table 2: Fish species collected by FGFWFC (1957) in pre-channelized broadleaf marsh.

GAME FISH:	
Centrarchidae	
Micropterus salmoides	largemouth bass
Lepomis auritrus	redbreast sunfish
Lepomis machrochirus	bluegill
Lepomis gulosus	warmouth
Lepomis microlophus	redear sunfish
Pomoxis nigromaculatus	black crappie
Esocidae	
Esox americanus	redfin pickerel
CATFISH:	
Ictaluridae	
Ameiurus catus	white catfish
Ictalurus punctatus	channel catfish
FORAGE FISH:	
Aphredoderidae	
Aphredoderus sayanus	pirate perch
Atherinidae	
Labidesthes sp.	silverside
Centrarchidae	
Elassoma evergladei	Everglades pygmy sunfish
Ennecanthus gloriosus	blue-spotted sunfish
Cyprinodontidae	
Fundulus chrysotus	golden topminnow
Lacania goodei	bluefin killifish
Notemigonous crysoleucas	golden shinner
Notropis maculatus	tailight shinner
Notropis petersoni	coastal shinner

	Ictaluridae	
	Noturus gyrinus	tadpole madtom
	Percidae	
	Etheostoma fusiforme	swamp darter
	Poeciliidae	
	Gambusia holbrooki	eastern mosquitofish
	Heterandria formosa	least killifish
ROUGH FISH:		
	Catostomidae	
	Erimyzon sucetta	lake chubsucker

Table 3. Exotic fish species occurring within South Florida that could invade the restored Kissimmee River ecosystem.

Species	Common Name
Belonesox belizanus	pike killifish
Cichlasoma bimaculatum	black acara
Cichlasoma citrinellum	midas cichlid
Cichlasoma meeki	firemouth
Cichla ocellaris	peacock bass
Cichlasoma octofasciatum	Jack Dempsey
Cichlasoma uropthalmus	Mayan cichlid
Hemichromis bimaculatus	jewelfish
Hypostomus sp.	suckermouth catfish
Monopterus albus	Asian Swamp eel
Tilapia mariae	spotted tilapia
Tilapia mossambica	Mozambique tilapia

Table 4. Body lengths for age class determination of centrarchid and esocid species in the Kissimmee River (modified from Carlander 1977 and Lee et al. 1980).

Species	Young-of the year	Juvenile
Esox ameicanus (redfin pickerel)	--	< 250 mm
Esox niger (chain pickerel)	--	< 300 mm
Micropterus salmoides (largemouth bass)	0-64 mm	65-120 mm
Lepomis auritrus (redbreast sunfish)	0-35 mm	36-60 mm
Lepomis gulosus (warmouth)	0-32 mm	33-75 mm
Lepomis machrochirus (bluegill)	0-45mm	46-90 mm
Lepomis microlophus (redear sunfish)	0-56 mm	57-134 mm
Lepomis punctatus (spotted sunfish)	--	<55 mm (SL)
Pomoxis nigromaculatus (black crappie)	0-51 mm	52-130 mm

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